

WHAT IS CLAIMED IS:

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1. A solid-state image pickup apparatus  
comprising:
  - a photoelectric conversion unit;
  - 5 transfer means for transferring signal charges  
from said photoelectric conversion unit;
  - capacitance means for holding the transferred  
signal charges; and
  - amplification means for outputting a signal
  - 10 corresponding to the signal charges held by said  
capacitance means,
  - wherein said capacitance means having a  
capacitance unit including a first capacitance value  
and an additive capacitance unit for adding a
  - 15 capacitance to said capacitance unit to increase the  
first capacitance value to obtain a second capacitance  
value, and
  - wherein a signal read-out from said amplification  
means has a first read-out mode in which a signal is
  - 20 read out while holding the signal charges in said  
capacitance unit and said additive capacitance unit,  
and a second read-out mode in which a signal is read  
out while holding the signal charges in said  
capacitance unit.
  - 25
2. An apparatus according to claim 1, further  
comprising at least one different additive capacitance

unit for further adding a capacitance to said capacitance unit and said additive capacitance unit,

wherein read modes in which a signal is read out from said amplification means while holding the signal charges in said capacitance means in correspondence with each of capacitance values obtained by adding said different additive capacitance unit to each of said capacitance unit and said additive capacitance unit are prepared in number corresponding to the number of different additive capacitance units.

3. A solid-state image pickup apparatus comprising:

a photoelectric conversion unit;

capacitance means for holding signal charges transferred from said photoelectric conversion unit;

a transfer field effect transistor for transferring the signal charges from said photoelectric conversion unit and adding a capacitance formed by a channel to said capacitance means to increase a capacitance value; and

amplification means for outputting a signal corresponding to the signal charges held by said capacitance means or the signal charges held by said capacitance means and the capacitance of said transfer field effect transistor,

wherein a signal read-out from said amplification

means has a first read-out mode in which a signal is read out while holding the signal charges in said capacitance means and the capacitance of said transfer field effect transistor, and a second read-out mode in which a signal is read out while holding the signal charges in said capacitance means.

4. A solid-state image pickup apparatus comprising:

10 a photoelectric conversion unit;

first and second transfer means for transferring signal charges from said photoelectric conversion unit;

15 first capacitance means, inserted between said first transfer means and said second transfer means, for holding the transferred signal charges;

second capacitance means, arranged on an output side of said second transfer means, for holding the transferred signal charges; and

20 amplification means for outputting a signal corresponding to the signal charges held by said first and second capacitance means or the signal charges held by said second capacitance means,

25 wherein a signal read-out from said amplification means has a first read-out mode in which a signal is read out while holding the signal charges in said first and second capacitance means, and a second read-out mode in which a signal is read out while holding the

signal charges in said second capacitance means.

5        5. An apparatus according to claim 1, further comprising means for adding output signals in the respective read-out modes.

10       6. An apparatus according to claim 3, further comprising means for adding output signals in the respective read-out modes.

      7. An apparatus according to claim 4, further comprising means for adding output signals in the respective read-out modes.

15       8. A solid-state image pickup apparatus comprising:

      a photoelectric conversion unit;

      transfer means for transferring signal charges from said photoelectric conversion unit;

20       capacitance means for holding the transferred signal charges; and

      amplification means for outputting a first signal without holding any signal charges in said capacitance means and outputting a second signal corresponding to the signal charges while keeping the signal charges held by said capacitance means,

25

      wherein said capacitance means including a

capacitance unit having a first capacitance value and  
an additive capacitance unit for adding a capacitance  
to said capacitance unit to increase the first  
capacitance value to obtain a second capacitance value,  
5 and

wherein a first signal read-out from said  
amplification means has a first non-holding read-out  
mode in which a signal is read out from said  
capacitance unit without holding any signal charges,  
10 and a second non-holding read-out mode in which a  
signal is read out from said capacitance unit and said  
additive capacitance unit without holding any signal  
charges, and

a second signal read-out from said amplification  
15 means has a first holding read-out mode in which a  
signal is read out while keeping the signal charges  
held by said capacitance unit, and a second holding  
read-out mode in which a signal is read out while  
keeping the signal charges held by said capacitance  
20 unit and said additive capacitance unit.

9. An apparatus according to claim 8, wherein  
further comprising at least one different additive  
capacitance unit for further adding a capacitance to  
25 said capacitance unit and said additive capacitance  
unit,

wherein non-holding read-out modes in which a

signal is read out from said amplification means  
without holding any signal charges in said capacitance  
means in correspondence with each of capacitance values  
obtained by adding said different additive capacitance  
5 unit to each of said capacitance unit and said additive  
capacitance unit, and holding read-out modes in which a  
signal is read out from said amplification means while  
keeping the signal charges held by said capacitance  
means in correspondence with each of capacitance values  
10 obtained by adding said different additive capacitance  
unit to each of said capacitance unit and said additive  
capacitance unit are prepared in number corresponding  
to the number of different additive capacitance units.

15 10. A solid-state image pickup apparatus  
comprising:

a photoelectric conversion unit;  
capacitance means for holding signal charges  
transferred from said photoelectric conversion unit;  
20 a transfer field effect transistor for  
transferring the signal charges from said photoelectric  
conversion unit and adding a capacitance formed by a  
channel to said capacitance means to increase a  
capacitance value; and

25 amplification means for outputting a first signal  
without holding any signal charges in said capacitance  
means and outputting a second signal corresponding to

the signal charges held by said capacitance means or  
the signal charges held by said capacitance means and  
the capacitance of said transfer field effect  
transistor,

5            wherein a first signal read-out from said  
amplification means has a non-holding read-out mode in  
which a signal is read out from said capacitance means  
without holding any signal charges, and

10           a second signal read-out from said amplification  
means has a first holding read-out mode in which a  
signal is read out while keeping the signal charges  
held by said capacitance means and the capacitance of  
said transfer field effect transistor, and a second  
15           holding read-out mode in which a signal is read out  
while keeping the signal charges held by said  
capacitance means.

11. A solid-state image pickup apparatus  
comprising:

20           a photoelectric conversion unit;  
             first and second transfer means for transferring  
signal charges from said photoelectric conversion unit;  
             first capacitance means, inserted between said  
first transfer means and said second transfer means,  
25           for holding the transferred signal charges;  
             second capacitance means, arranged on an output  
side of said second transfer means, for holding the

transferred signal charges; and

amplification means for outputting a first signal  
without holding any signal charges in said first and  
second capacitance means or said second capacitance  
5 means and outputting a second signal corresponding to  
the signal charges held by said first and second  
capacitance means or said second capacitance means,

wherein a first signal read-out from said  
amplification means has a first non-holding read-out  
10 mode in which a signal is read out from said first and  
second capacitance means without holding any signal  
charges, and a second non-holding read-out mode in  
which a signal is read out from said second capacitance  
means without holding any signal charges, and

15 a second signal read-out from said amplification  
means has a first holding read-out mode in which a  
signal is read out while keeping the signal charges  
held by said first and second capacitance means, and a  
second holding read-out mode in which a signal is read  
20 out while keeping the signal charges held by said  
second capacitance means.

12. An apparatus according to claim 8, further  
comprising first addition means for adding output  
25 signals in the respective non-holding read-out modes,  
second addition means for adding output signals in the  
respective holding read-out modes, and subtraction



means for subtracting an output from said first addition means from an output from said second addition means.

5           13. An apparatus according to claim 10, further comprising first addition means for adding output signals in the respective non-holding read-out modes, second addition means for adding output signals in the respective holding read-out modes, and subtraction  
10 means for subtracting an output from said first addition means from an output from said second addition means.

          14. An apparatus according to claim 11, further  
15 comprising first addition means for adding output signals in the respective non-holding read-out modes, second addition means for adding output signals in the respective holding read-out modes, and subtraction  
20 means for subtracting an output from said first addition means from an output from said second addition means.

          15. An apparatus according to claim 8, further comprising subtraction means for subtracting an output  
25 signal in the read-out mode from an output signal in the holding read-out mode when the capacitance values are equal or substantially equal in correspondence with

the number of capacitance values varying.

16. An apparatus according to claim 10, further comprising subtraction means for subtracting an output  
5 signal in the read-out mode from an output signal in the holding read-out mode when the capacitance values are equal or substantially equal in correspondence with the number of capacitance values varying.

10 17. An apparatus according to claim 11, further comprising subtraction means for subtracting an output signal in the read-out mode from an output signal in the holding read-out mode when the capacitance values are equal or substantially equal in correspondence with  
15 the number of capacitance values varying.

18. An apparatus according to claim 1, wherein said additive capacitance unit or said additive  
20 capacitance unit and said different additive capacitance unit comprise variable capacitive elements electrically connected in parallel to said capacitance unit.

19. An apparatus according to claim 8, wherein  
25 said additive capacitance unit or said additive capacitance unit and said different additive capacitance unit comprise variable capacitive elements

electrically connected in parallel to said capacitance unit.

20. An apparatus according to claim 8, wherein the  
5 order of the first non-holding read-out mode and the second non-holding read-out mode is the same as that of the first holding read-out mode and the second holding read-out mode.

10 21. An apparatus according to claim 11, wherein the order of the first non-holding read-out mode and the second non-holding read-out mode is the same as that of the first holding read-out mode and the second holding read-out mode.

15 22. A solid-state image pickup apparatus using, as an area sensor, said solid-state image pickup apparatus of any one of claims 1 to 21.

20 23. A solid-state image pickup apparatus using, as a line sensor, said solid-state image pickup apparatus of any one of claims 1 to 21.

25 24. A signal read-out method for a solid-state image pickup apparatus which holds, in capacitance means, signal charges generated by a photoelectric conversion unit and outputs a signal corresponding to

the signal charges held by said capacitance means from amplification means, comprising

5 a first read-out mode in which a signal is output from said amplification means while holding the signal charges generated by said photoelectric conversion unit in said capacitance means set at a first capacitance value, and

10 a second read-out mode in which, after the first read-out mode, the capacitance value of said capacitance means is changed from the first capacitance value to a second capacitance value, and a signal corresponding to the signal charges held by said capacitance means set at the second capacitance value is output from said capacitance means.

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25. A method according to claim 24, further comprising at least one read-out mode in which, after the second read-out mode, the capacitance value of said capacitance means is changed from the second  
20 capacitance value to an arbitrary capacitance value, and a signal corresponding to the signal charges held by said capacitance means set at the arbitrary capacitance value is output from said amplification means.

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26. A signal read-out method for a solid-state image pickup apparatus, comprising:

a holding read-out mode in which a signal corresponding to signal charges generated by a photoelectric conversion unit is output from amplification means while keeping the signal charges held by capacitance means; and

a non-holding read-out mode in which a signal is output from said amplification means without holding any signal charges in said capacitance means,

wherein the holding read-out mode has a first holding read-out mode in which a signal is output from said amplification means while keeping the signal charges held by said capacitance means set at a first capacitance value, and a second holding read-out mode in which a signal is output from said amplification means while keeping the signal charges held by said capacitance means whose capacitance value is set at a second capacitance value different from the first capacitance value, and

the non-holding read-out mode has a first non-holding read-out mode in which a signal is output from said amplification means without holding any signal charges in said capacitance means set at the first capacitance value, and a second non-holding read-out mode in which a signal is output from said amplification means without holding any signal charges in said capacitance means whose capacitance value is set at the second capacitance value different from the

first capacitance value.

27. A method according to claim 26, further comprising:

5 at least one holding read-out mode in which the capacitance value of said capacitance means is changed from the second capacitance value to an arbitrary capacitance value, and a signal is output from said amplification means while keeping the signal charges  
10 held by said capacitance means set at the arbitrary capacitance value; and

at least one non-holding read-out mode in which the capacitance value of said capacitance means is changed from the second capacitance value to an  
15 arbitrary capacitance value, and a signal is output from said amplification means without holding any signal charges in said capacitance means set at the arbitrary capacitance value.

20 28. A signal read-out method for a solid-state image pickup apparatus, comprising:

a holding read-out mode in which a signal corresponding to signal charges generated by a photoelectric conversion unit is output from  
25 amplification means while keeping the signal charges held by capacitance means; and

a non-holding read-out mode in which a signal is

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output from said amplification means without holding  
any signal charges in said capacitance means,

wherein the holding read-out mode has a first  
holding read-out mode in which a signal is output from  
5 said amplification means while keeping the signal  
charges held by said capacitance means set at a first  
capacitance value, and a second holding read-out mode  
in which a signal is output from said amplification  
means while keeping the signal charges held by said  
10 capacitance means whose capacitance value is set at a  
second capacitance value different from the first  
capacitance value, and

the non-holding read-out mode has a non-holding  
read-out mode in which a signal is output from said  
15 amplification means without holding any signal charges  
in said capacitance means set at the second capacitance  
value.

29. A solid-state image pickup apparatus including  
20 a plurality of pixels, each pixel comprising:

a photoelectric conversion unit;  
holding means for holding a signal from said  
photoelectric conversion unit;  
read-out means for reading out the signal held by  
25 said holding means; and  
capacitance changing means for changing a  
capacitance value of said holding means.

30. An apparatus according to claim 29, further comprising control means having a first mode in which a signal is read out from said read-out means while keeping said holding means set at a first capacitance value by said capacitance changing means, and a second mode in which a signal is read out from said read-out means while keeping said holding means set at a second capacitance value by said capacitance changing means.

31. An apparatus according to claim 30, further comprising addition means for adding the signal read out in the first mode and the signal read out in the second mode.

32. A solid-state image pickup apparatus comprising:

a photoelectric conversion unit; and  
a charge/voltage conversion unit for converting signal charges transferred from said photoelectric conversion unit into a signal voltage,  
wherein said charge/voltage conversion unit comprises a plurality of capacitances having different dependences on voltage.

33. An apparatus according to claim 32, wherein said charge/voltage conversion unit comprises an impurity diffusion region and a MOS structure unit, and



the plurality of capacitances having different dependences on voltage comprise a capacitance formed in the impurity diffusion region and a capacitance formed in said MOS structure unit.

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34. An apparatus according to claim 32, wherein said charge/voltage conversion unit comprises an impurity diffusion region and a buried semiconductor junction portion, and the plurality of capacitances having different dependences on voltage comprise a capacitance formed in the impurity diffusion region and a capacitance formed in said buried semiconductor junction portion.

35. An apparatus according to claim 34, wherein the dependence of the capacitance formed in said buried semiconductor junction portion on voltage is controlled by an impurity concentration or depth of a semiconductor region of one conductivity type of said semiconductor junction portion.

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36. An apparatus according to claim 35, wherein the dependence of the capacitance formed in said buried semiconductor junction portion on voltage is controlled by a width of a semiconductor region of one conductivity type of said semiconductor junction portion.

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37. An apparatus according to claim 32, further comprising reset means for applying a reset voltage to reset said charge/voltage conversion unit, wherein a charge/voltage conversion efficiency of said  
5 charge/voltage conversion unit is controlled by controlling a voltage value of the reset voltage.

38. An apparatus according to claim 37, further comprising sampling means for sampling a light amount  
10 incident on said photoelectric conversion unit, wherein the reset voltage is set in accordance with a sampling signal from said sampling means.

39. An apparatus according to claim 38, wherein  
15 the sampling signal is a signal one frame ahead.

40. An apparatus according to claim 38, wherein the sampling signal is one of an overflow drain signal and a smear signal.  
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41. An apparatus according to claim 38, wherein before an accumulation period of the signal charges, second signal charges accumulated in an accumulation period shorter than the accumulation period are  
25 transferred to the impurity diffusion region, and the second signal charges are used as the sampling signal.

42. A solid-state image pickup apparatus including a plurality of pixels, each pixel comprising:

a photoelectric conversion unit;

5 a charge/voltage conversion unit for generating a voltage corresponding to a charge amount of the signal charges from said photoelectric conversion unit;

10 control means for controlling to change a charge/voltage conversion efficiency of said charge/voltage conversion unit in accordance with the charge amount of the signal charges; and

read-out means for reading out the voltage generated by said charge/voltage conversion unit to an output line.

15 43. An apparatus according to claim 42, wherein said control means comprises reset means for applying a reset voltage to reset said charge/voltage conversion unit, and the charge/voltage conversion efficiency of said charge/voltage conversion unit is controlled by  
20 controlling a voltage value of the reset voltage.

44. A solid-state image pickup apparatus including a plurality of pixels, each pixel comprising:

a photoelectric conversion unit;

25 a charge/voltage conversion unit for generating a voltage corresponding to a charge amount of the signal charges from said photoelectric conversion unit; and

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wherein a charge/voltage conversion efficiency of  
5 said charge/voltage conversion unit changes in  
accordance with the charge amount of the signal  
charges.